Climate-Related Extreme Events: A review of adaptation options

Kees Stigter
Department of Environmental Sciences
Chair Group of Meteorology and Air Quality
Wageningen University
Duivendaal 2, 6701 AP Wageningen
The Netherlands
E-mail: kees.stigter@user.metair.wau.nl
Tel: 31 317 483 332
Fax: 31 317 482 811

Learning objectives

As you work through this session you will:

- Become familiar with the concept of resilience to climate-related disasters and the meteorological factors affecting sustainable agricultural production
- Understand some of the conditions in farming systems
- Understand the importance of incorporating traditional knowledge and indigenous technology
- Become familiar with selected applied research and operational services

In a review of adaptation options to climate related extreme events, it has been observed that most resilience to disasters was built up from local adaptive strategies to cope with climate variability, based on traditional knowledge and indigenous technology.

The IPCC high and medium confidence scenarios regarding the consequences of increasing climate variability and climate change for agricultural production in Asia, as well as the adaptation options formulated in the IPCC reports for different parts of Asia, are useful as starting points for considering adaptation. However, they only give indications of the problems we may be facing. Solutions must be found and institutional arrangements must be created or improved for supporting these solutions.

Strategies to deal with adaptations to extreme climate events are not different now from what they have always been. They have only become more urgent. New technologies may have to be developed to add to existing ones to cope with future impacts and to reduce the adaptation costs.

In addition to the increased frequency of hazardous events, it should be recognized that disaster frequency and losses are also due to growing exposure and increasing vulnerability. Adaptation options should therefore be particularly assessed for reducing vulnerability and exposure to the risks of disasters wherever possible.

The best known services to assist in adopting adaptation strategies are presently those that help reduce the impacts of natural disasters, including pests and diseases, and those of monitoring for early warning systems. They should particularly increase preparedness—getting/providing the right information, geared towards the conditions and needs of the target group. This information must be provided at the right time, through the right means, for the right purpose. These services, including the use of climate (forecast) information, are currently still rather incomplete and insufficiently beneficial to farmers.

Pilot projects and demonstration projects using climate (forecast) information for farmers' decision making carry a string of minimum conditions for potential success. These projects have been derived and reformulated using an actual successful—but still limited—case study. Most of the projects were developed through a theoretical approach.

As noted in Session 3.1 on "Opportunities to improve the use of seasonal climate forecasts", we have learned on the present subject that:

- Most resilience to disasters has been built up from local adaptive strategies to cope with climate variability, based on traditional knowledge and indigenous technology
- Other adaptation options, based on modern science and technology, must take the conditions and innovations of farmers and farming systems as a starting point to diminish risks and make these options acceptable
- Pilot projects should by demonstration enhance acceptability and lower risks for the farmers even further

One very indirect adaptation option, ie., developing services to help reduce the contributions of agricultural production to global warming, may not be effective in reducing farmers' risks from climate-related extreme events. In a WMO/CAgM meeting in Accra in 1999 scientists were of the opinion that developing countries may try to mitigate greenhouse gases in this way. However, these measures should be undertaken only in conjunction with other adaptation options that have clear advantages for their land use. They should adhere to the priorities that farmers have defined:

- Improved efficiency of fertilizer use
- Improved ruminant digestion;
- Growing biomass more efficiently (including the promotion of agro-forestry)
- Altering management of agricultural soils and rangelands.

These measures may be implemented with the added benefit of decreasing greenhouse gases or increasing their absorption.

More generally one may mention the importance of Land Use Change/Land Cover Change (LULUCF) feedback situations with climate change, in which factors other than greenhouse gases play a role. These are environmental policy matters to be considered in planning at the government level.

Meteorological Parameters Involved in Disasters Endangering Sustainable Agricultural Production

According to the IPCC, agricultural productivity in Asia is likely to suffer severe losses due to high temperatures, severe drought, floods, and soil degradation. The Third Assessment Report presents two high confidence scenarios:

1. Climate change and variability will exacerbate vulnerability to extreme climate events such as drought and floods
2. Crop production and aquaculture will be threatened by a combination of thermal and water stresses, sea level rise, increased flooding, and strong winds associated with intense tropical cyclones

In addition there are also two relevant medium confidence scenarios:

1. Increased precipitation intensity, particularly during the summer monsoon in temperate and tropical Asia, will increase the flood prone areas, while areas suffering from occasional dry spells will have more serious ones; in arid and semi-arid Asia droughts will be on the rise
2. Tropical cyclones could become more intense

Adaptation Options

The IPCC report mentions three very general adaptation options for agriculture in tropical Asia:

- Adjust the cropping calendar and crop rotation
- Develop and promote suitably high yielding varieties
- Develop sustainable technological options, including improving productive resources, inputs, knowledge, and services

Adaptation Options for Temperate Asia

- Soil conservation
- Heat resistant crops
- Water efficient cultivars with resistance to pests and diseases

Adaptation Options for Arid and Semi-arid Asia

- Protection from soil degradation
- Shift away from conventional crops

Adaptation Options for Water Resources

For water resources the options mentioned (particularly for tropical Asia, but also for temperate Asiawith respect to drought and floods, which affect more people than all other natural disasters combined, also for temperate Asia) are all of importance to agriculture:

- Develop flood control management systems
- Develop drought control management systems
- Reduce future developments in flood plains
- Take appropriate measures for protection from soil erosion
- Conserve groundwater supplies
- Harvest water may be made
- Develop efficient water resources systems

Application of Adaptation Options

Is there such a thing as a general adaptation option? They are just a first choice of directions in which solutions may be found, together with institutional arrangements. In each direction, one may then get more detailed. For drought and water resources, there are agronomical adaptation measures that can be, and have been, taken. These range from the time of planting, practicing water conservation techniques, using crops with very extensive and deep rooting systems, to planting drought resistant varieties. There are also simple agro-meteorological ways in which water use efficiency of crops in drylands can be improved, e.g. tillage in the fallow period, mulching, soil moisture management with adapted fertilization, crop rotation and multiple cropping.

Adapting to changing climate conditions has in fact been done for thousands of years in the agriculture sector. The pace of change is only now more urgent. This is well illustrated by a statement on applying future adaptation measures in China to combat increasing climate variability in agriculture:

> ***"The response strategies include changing the topography to reduce run off, improve water uptake and reduce wind erosion, introducing artificial systems to improve water availability and to control soil erosion, changing farming practices to conserve soil moisture and nutrients, changing farm operations timing to fit new climatic conditions and using different crops or varieties to match variations in the water supply and temperature conditions. … In the course of time new technologies may have to be***

> ***developed to cope with anticipated impacts and to reduce the costs of adaptation."***

As soon as farmers, NGOs, governments and applied scientists have agreed on the most urgent local priorities to be tackled, the actual adaptation options in their case must be jointly determined. It is at such moments that the scenarios for increasing climate variability and climate change should be used as additional arguments for or against certain measures. The adaptation measures may make use of the options suggested, but the local conditions should prevail in the arguments. If farmers and those officially responsible for policy environments and adaptation strategies do not jointly determine the adaptation steps, then the success outlook of such strategies is limited.

For Africa and Asia, this means that adaptation options should particularly be assessed for reduction of vulnerability and of exposure to risks of disaster. However, if, for example, people are forced to use sloping land or land in rain shadows of mountains, this increases vulnerability. This cannot be combated by risk evasion, although risk reduction through cultivation measures or crop choice may help.

Services for Adopting Adaptation Strategies

The further development of effective agro-meteorological services to assist farmers is needed in developing countries. Below are two examples of the priority services that may assist in the adoption of adaptation strategies. The examples come from the summary and recommendations of a WMO/CAgM Workshop on Agrometeorology in the 21st Century (Stigter et al., 2000).

Services to Help Reduce the Impact of Natural Disasters, Including Pests and Diseases

This type of service is useful where climatic disasters occur and users are assisted. This applies to the following cases:

- Possibilities of permanent improvements of the microclimate for crop growth
- Other aspects of action that may be taken when general information is forecasted on changes in seasonal climate patterns
- Examples of response farming

Two issues are of some particular interest. These are the factor of "preparedness" and the "public/private" debate. As to preparedness, there are examples of combating desertification (Nigeria), preparation of agro-climatic maps of disasters for planning (Malaysia), the existence of contingency plans and the availability of crisis managers for the supplies (India), broadcasting of agro-meteorological information (Mali), but also the negative examples in Vietnam and in India.

Preparedness is a matter of getting or providing the right information, geared to the conditions and needs of the target group, at the right time, with the right means, for the right purpose.

The organizational power of governments is often insufficient in practice, for various reasons, and this is the first thing that must be improved to give provincial agro-meteorologists something useful they can communicate to the farmers and their extension services.

Three examples from Africa illustrate simple advisories that could easily be given but are not:

- In Nigeria, either a validated on-line determination of sufficient rainfall, or simple soil moisture measurements on the spot, could be used by a team of agro-meteorologists to determine the optimal sowing time for the farmers concerned.
- In Gambia, unseasonal rains could be forecasted and broadcasted from the incursion of polar air. This would make it possible for farmers to cover their outdoor drying peanuts, preventing a price depreciation of 40%.
- In Sierra Leone, two seasons of storms occur in which it is not possible to go out for fishing. Storm forecasting would be able to forecast seven days in advance. During these periods, 14 days of fishing produces a value of US$400,000 on a national basis.

In these and other cases, one could contemplate the possibilities for involving private enterprises and a market approach. In Accra, people believed that disaster preparedness should remain primarily a public affair, especially since disasters occur on a national scale. Joint ventures between private capital and the government, or fully private undertakings, are feasible in pest and diseases control. This type of joint venture exists in developed countries, and small scale disaster forecasting is possible as illustrated above. The users must be able to pay for the private advisories.

Monitoring for “Early Warning” Systems

Early warning systems and services have been requested under the programs of Agenda 21 (UNCED), UNCCD and WFSPA, which shows that there is much support for their implementation. Crop models with agro-meteorological components could be combined with such early warnings to provide a “Famine Early Warning System”.

Drought

The drought monitoring and early warning systems in Africa started after the 1972-73 droughts. Radio stations broadcasted 10-day bulletins that followed the ongoing rainy season. These bulletins contributed significantly to reducing the impacts of the 1983-84 droughts, even though those droughts were more severe.

Two drought monitoring centers have been established, one in Nairobi, Kenya, and the other in Harare, Zimbabwe. They are sub-regional climate diagnostic centers with the main objective to monitor drought and provide prognostic advice to member countries. They publish a monthly drought monitoring bulletin and a ten-day advisory bulletin. These bulletins contain climatological summaries, drought severity indices, agro-meteorological conditions and their impacts, synoptic reviews, and outlooks.

A case study in Botswana on the use of the drought monitoring bulletin and other local information provided by agricultural demonstrators, who are closest to the farmers, concluded that a lot more work remains to be done. Until then, farmers are not yet receiving a great benefit from the information. Large-scale adaptation strategies are still mostly theoretical in nature. Nevertheless, droughts longer take farmers completely by surprise.

Floods

It is interesting to note that in agro-meteorology, there is little reporting on the prevention of flood damage through improved tropical cyclone monitoring and warning systems. There are few operational ways to counteract serious floods. Traditional drainage ditches and tunnels through wheat fields have been reported in China as adaptation strategies.

Desertification

Desertification is another typical example of an issue where monitoring and warning are insufficient. Even in China, where this is a most serious issue, decades of monitoring the increasing sand storms have not led to sufficiently developed measures to draw best practices for adaptation strategies. On a smaller scale, successful measures have been developed. However, the closure of the UNEP Desertification Unit, which produced "Desertification Control Bulletins", has created a policy environment that is much less conducive to action.

Finally, improved forecasting of favorable conditions could be opportunities to take advantage of changed climate conditions. With climate forecasting, this option is already built in more easily than in the monitoring for early warning approaches. In all these aspects, the monitoring scales are of course again of great importance. One should think in long-term adaptation strategies, but in the short term, the focus could be on which adaptation measures should be taken.

Establishment of Pilot Projects

The benefits of climate prediction have been demonstrated. The science and models-based seasonal predictions have produced adaptation strategies here and there in industrial countries. This is also possible under the social and economical conditions in developing countries, as was shown in India, but there has been relatively little work in this direction. Pilot projects in agro-meteorology have shown their value in Africa, although very often scaling up to larger areas or other countries leaves very much to be desired. It has also been suggested that when designing adaptation strategies, there are minimum conditions for successfully using seasonal climate predictions:

- Availability of historical data, including the variability of agricultural production, the variability of climate, and the relation between the two;

- Statistical analyses of the influence of climate variability on yields and on the influence of any changes in management technologies that have been involved in the recent past;
- Predictability of climate variations and of variations in regional crop yields;
- Availability of models for simulating or otherwise determining the effects of management strategies;
- Operational climate prediction systems that are able to predict various climatic issues that are important to management decisions.

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